

13. *A Monographic Revision of the Genus Breviceps, with Distribution Records and Descriptions of New Species.*—By J. H. POWER, F.Z.S.

(With Plates XXXIX–XLIII.)

IN working through certain of the frogs and toads some time ago, I was surprised at the very unsatisfactory state of the synonymy of this genus.

It may be well at the outset to give a résumé of the history of the genus.

The attention of scientists was first drawn to this peculiarly South African toad by Linné in 1758,* when he described a specimen from the Cape under the name of *Rana gibbosa*. Sixty-two years later, in 1820, the genus *Breviceps* was made by Merrem † with Linné's species as the type.

Next *B. verrucosus* was described by Rapp,‡ in 1842, from material collected in Natal.

In 1855, Peters described § *B. mossambicus* from a collection made on the island of Mozambique and at Sena. The same author in 1882 || referred to another form in a more or less passing sort of way. He says: "Another not yet described variety is *B. adspersus*, Peters, which I obtained between the 25° and 26° Lat. S., from the Transvaal as well as from Damaraland, S.W. Africa. On the back, but especially on the sides, of the body are scattered granules, whereas the belly is smooth."

Werner described ¶ another new form, from "perhaps Grahams-town," under the name *B. pentheri*, in 1899.

B. macrops was described from Namaqualand by Boulenger ** in 1907, and quite recently (January 1925) Hewitt †† has described three new species under the names *B. fuscus*, *B. tympanifer*, and *B. parvus*.

* Systema Naturae (10th edition), vol. i, p. 211.

† Trent. Syst. Amph., p. 177.

‡ Arch. Naturg., vol. viii, pt. i, p. 291.

§ *Ibid.*, vol. xxi, pt. i, p. 58.

|| Reise nach. Mossamb., vol. iii, p. 177.

¶ Zool. Anz., No. 581, p. 116.

** Ann. Mag. Nat. Hist., (7), vol. xx, p. 46.

†† Ann. Natal Mus., vol. v, pt. 2, p. 189.

Later still, in a paper read before the Zoological Society of London, on 21st April 1925, Mr. Loveridge describes another new species which he calls *Breviceps uluguruensis*.

From the description and figure given of this specimen, taken in the Uluguru Mountains, Tanganyika Territory, it is clearly not a member of the genus *Breviceps*.

As already stated, Werner described *B. pentheri*, in 1899, from what was evidently an immature specimen (15 mm. long), but afterwards reduced it to a synonym of *B. verrucosus*; while Boulenger,* in 1910, put both as synonyms of *B. gibbosus*, so that in his revised list † he recognises only four species, *B. gibbosus*, *B. adspersus*, *B. mossambicus*, and *B. macrops*. There is no doubt that the species named *adspersus* by Peters, and that so named by Boulenger, are quite different forms. So obvious a distinction as the larger eye-opening, by which Boulenger separates it from *gibbosus*, would certainly have been noticed and mentioned by Peters. Most probably Peters' *adspersus* is the same as the specimens in the Transvaal Museum from Kastrol Nek, which I refer to Hewitt's recently described *parvus*, though Hewitt considers the Grahamstown examples of the species as possibly the same as *B. pentheri*.

Again, Hewitt says ‡: "It seems very probable that *pentheri*, Wern., and *adspersus*, Pet., are the same, and I cannot separate them from *mossambicus*, Pet."

"The Kimberley species, which I provisionally referred to *pentheri*, is presumably the same as *adspersus*, Pet."

The form occurring at Kimberley is now definitely known to be *mossambicus*.

As regards *verrucosus*, Rapp, Hewitt says §: "Recently I have compared Rapp's description with material in the British Museum collection, and though unable to identify it with any known species, am content to believe that *verrucosus* is really based on material from Natal (coll. Krauss), as stated in his description, the illustration apparently representing a species in which the fourth finger is much shorter than the second; in any case, Rapp's figure is unlike the Knysna specimens in pigmentation and in the nature of granulation."

At one time Boulenger put specimens from Knysna under *verrucosus*, but, as stated above, afterwards put the species as a synonym of

* Ann. S. Afr. Mus., vol. v, pt. 9, p. 534.

† Boulenger, *loc. cit.*

‡ Ann. Trans. Mus., vol. iii, No. 1, p. 54.

§ Ann. Natal Mus., vol. v, pt. 2, p. 192.

gibbosus. Hewitt * has now described the Knysna form under the name *B. fuscus*, and in the concluding sentence of his description of *B. tympanifer*, he says: "This species I might perhaps have referred to *verrucosus*, Rapp, but for the fact that the description thereof includes 'Das Trommelfell verdeckt.'"

Such then, in brief, is the history of the systematics of the genus. In the present paper four new species are being added.

Thanks to the directors of the various museums, the author has been able to examine a large series of specimens from all parts of the Union, Rhodesia, and Portuguese East Africa.

The relative lengths of the second and fourth fingers were taken as a primary means of separating the various species, but as the work of examination proceeded, it was found that many specimens grouped according to this definition with *B. gibbosus* were in other respects near *mossambicus*.

Each of the diagnostic characters given in Boulenger's revised list was then taken separately, tested through a large series of specimens, and the results tabulated. These showed such variation, and in many cases overlapping, that it became evident that averages only could show the true state of things. The averages, therefore, in addition to the ranges of variation, are given on page 459.

Other characters described hereafter were then explored as possible means of separating the different forms.

SNOUT INTO BODY.

When typical specimens of each of the existing species were put side by side, the difference in the appearance of the snout was so striking that it was examined as a possible source of diagnosis (see Plate XXXIX, figs. 1, 4, and 8). The proportions between the lengths of snout and body of ten specimens of *B. gibbosus* (Cape), twelve of *B. mossambicus* (various localities), four of *B. macrops* (Namaqualand), were taken with the following remarkable results:—

	Length of Snout † into Length of Body.‡
<i>B. gibbosus</i>	8 to 8 $\frac{5}{7}$ times.
<i>B. mossambicus</i>	4 $\frac{2}{3}$,, 5 $\frac{2}{3}$,,
<i>B. macrops</i>	3 $\frac{3}{8}$,, 4 $\frac{1}{3}$,,

* Hewitt, *loc. cit.*, p. 191.

† Measured from a line joining the posterior corners of the eye-openings to the tip of the snout between the nostrils.

‡ Measured from snout to vent.

It was now clear that this was an important character apparently overlooked by previous authors. The work of testing it through a large series of specimens was then undertaken. The results will be found in the table on page 459. (See also Plate XXXIX, figs. 1 to 10.)

BODY.

In two specimens from Table Mountain, and one from Hottentot's Holland, Caledon Div., the body is extremely rough throughout, even to the upper surface of the hands, arms, legs, and feet. In the Hottentot's Holland specimen the dorsal tubercles are comparatively large and crater-like, and in the Table Mountain specimen they are small and granular.

Specimens from St. John's, Transkei, have the body thickly covered throughout with small flat, pitted tubercles. In those from Knysna the body is very rough, especially the dorsal surface, and all round the head. There may be no distinct tubercles, but pits or ruts going in all directions, or there may be raised, warty tubercles scattered rather sparsely over the dorsal surface. Under the head they are very rough, but not so rough on the abdomen; the ventral tubercles may be rather small and flattened, or they may be quite smooth on the abdomen. Sometimes the posterior third of the dorsal surface, the sides, and the whole ventral surface except the chin are smooth.

Those from the Cape Peninsula, the home of typical *gibbosus*, are very rough throughout, covered with large flat tubercles or small pitted ones, which give them a crater-like appearance; occasionally the posterior quarter of the dorsal surface, the sides, and the whole ventral surface are quite smooth.

Certain specimens from Mariannahill and Umbilo, Natal, have the body above, together with the arms and legs, covered with small prominent tubercles. Ventrally, the centre of the abdomen is fairly smooth, the remainder having flattened tubercles, save under the head, which is covered with small tubercles as dorsally.

Typical specimens of *macrops* from Namaqualand are perfectly smooth throughout; the head, legs, feet, arms, and hands have a high polish. A very occasional specimen may be slightly rough above, through numerous tiny skin folds.

Of two specimens from Port Nolloth, one has the latter third dorsally, the sides, under the head, and the abdomen, finely granular. The other is perfectly smooth throughout, except under the head, where the skin is wrinkled, giving it a rough appearance. The upper surface is highly polished.

Specimens from various localities in the Cape Province, Natal, Transvaal, Rhodesia, and Portuguese East Africa I have placed as *B. mossambicus*; they show the following variations: Above, rough, with large flattened or small raised tubercles pitted all over with pores; below, smooth or slightly granular; or smooth throughout; or posterior half of body covered with flat tubercles; or with soft folds of the skin giving them a warty-looking appearance; or granular on the sides only.

A large series from Kastrol Nek, and specimens from Bindura, Barberton, Lourenço Marques, Masiene, and Komatipoort, were quite smooth above, pitted or with large flat tubercles; the skin at the sides slightly granular or folded irregularly, transverse folds in the region of the abdomen; below, smooth or slightly granular on the chin.

CHARACTER OF TUBERCLES UNDER FINGERS AND TOES.

In typical specimens of *B. gibbosus* (Plate XL, fig. *b*, 1 and 2) from the Cape Peninsula there is a large flat tubercle at the origin of each finger and toe, also under the middle joint of the longest finger and toe, but rather indistinct on the toes; sometimes the fingers and toes granulated or having a corrugated appearance. The palms of the hands and soles of the feet usually have the skin folded, giving them a wrinkled appearance, but they may have faint tubercles, or they may be smooth.

In specimens from Table Mountain (Plate XL, fig. *c*, 1 and 2), and one individual from Hottentot's Holland, Caledon Div., the palms of the hands and soles of the feet are extremely rough and granular, being thickly studded with prominent, small, rounded, or sub-conical rather hard tubercles. Specimens from St. John's (Plate XL, fig. *h*, 1 and 2), Transkei; Umbilo, Natal; and one from Mariannhill, have a large, flat, oval or round tubercle at the origin of each finger and toe, smaller ones on the palms of the hands; the soles of the feet studded with a mixture of small and large irregular ones. The individuals which occur at Knysna and George (Plate XL, fig. *d*, 1 and 2) may have a large flat tubercle at the beginning of each finger and toe, rather indistinct on the toes; or fingers and toes corrugated inferiorly, or a double sub-conical tubercle at the origin of each finger and toe and at the middle joint of the longest. The skin in folds on the palms of the hands and soles of the feet gives them a rugged appearance.

Specimens from Kastrol Nek (Plate XL, fig. *a*, 1 and 2), Barberton, Louw's Creek, Komatipoort, Lourenço Marques, Masiene, Inseleni,

have a large subconical tubercle at the origin of each finger and toe, also large rounded ones on the palms of the hands; or the whole surface of the hands finely granular; soles of the feet smooth. In the case of two specimens from Port Nolloth (Plate XL, fig. *g*, 1 and 2) the hands and feet are much the same, as regards roughness, as in those from Kastrol Nek, except that the tubercles are much smaller. As a rule the feet and hands in *B. macrops* (Plate XL, fig. *e*, 1 and 2) are perfectly smooth throughout; very occasionally a few indistinct tubercles may be found under both hands and feet.

It may be mentioned here that the fingers and toes of this species are very short and stumpy, the first, second, and fifth toes often being mere buds.

In *B. mossambicus* (Plate XL, fig. *f*, 1 and 2) there is a large chisel-shaped, rounded or flat tubercle under each joint of the fingers and the longest toe, also on the palms of the hands; soles of the feet smooth, or with a large flat tubercle at the base of each toe; sometimes palms of hands, fingers, and toes finely granular, or palms of hands smooth.

From the foregoing it will be seen that the genus reaches its maximum of roughness in *B. montanus*, giving a complete range of degrees through *gibbosus*, *fuscus*, *tympanifer*, *namaquensis*, *mossambicus* to *macrops*, which is more or less smooth throughout.

INNER AND OUTER METATARSAL TUBERCLES.

The differences in these characters among the typical forms are worthy of note. They consist of: the size and shape of the tubercles, the relationship between the base of the inner metatarsal tubercle and the axis of the longest toe, and whether or not it extends beyond the side of the foot.

In typical *mossambicus* (Plate XL, fig. *f*, 2) the inner metatarsal is large, with a rather blunt, or sometimes sharp, digging edge; not extending beyond the side of the foot; at right angles to the sole of the foot or directed inwards towards it. Base at from 40° to 45° to axis of longest toe. Outer metatarsal small, distinct from the inner, or hardly so.

The Kastrol Nek specimens (Plate XL, fig. *a*, 2) have a comparatively large inner metatarsal tubercle with a sharp digging edge at right angles to the sole of the foot, or directed inwards towards it; not reaching beyond the side of the foot; base at from 30° to 45° to axis of longest toe. Outer metatarsal small, scarcely distinct from the inner.

In typical *gibbosus* from the Cape (Plate XL, fig. *b*, 2) the inner metatarsal tubercle is large and thick, very blunt, practically no digging edge; projecting beyond the side of the foot; axis of base at from 50° to 60° to axis of longest toe. Outer metatarsal large and scarcely distinct from the inner.

In Knysna and George specimens the inner metatarsal tubercle is rounded and pebble-like; scarcely any digging edge; projecting beyond the side of the foot; axis of base at 60° to axis of longest toe. Outer metatarsal about half as large, united to or distinct from the inner.

Three specimens from Table Mountain (Plate XL, fig. *c*, 2) have a comparatively large, oval, pebble-like inner metatarsal; not projecting beyond the side of the foot; surface rounded, no digging edge; base at 30° to 40° to axis of longest toe. Outer metatarsal quite distinct from the inner; prominent.

In *B. macrops* (Plate XL, fig. *e*, 2) the inner metatarsal is long and narrow, rather indistinct, sharp cutting edge; not projecting beyond the side of the foot; axis of base 30° to axis of longest toe, or parallel thereto. Outer metatarsal absent, or very indistinct.

In the case of two specimens from Port Nolloth (Plate XL, fig. *g*, 2) the inner metatarsal is long and narrow, with sharp digging edge at right angles to the sole of the foot; base 30° to 50° to axis of longest toe. Outer metatarsal comparatively large, prominent, and having a slight indication of a digging edge continuous with that of the inner.

When all the available material had been examined, it was found that certain specimens from the Cape Flats, Table Mountain, Port Nolloth, Mariannahill, and Robben Island could not be placed under any of the existing definitions. One specimen in the S. African Museum from the Hottentot's Holland Mountains, Caledon Div. (Plate XLII, figs. 5 and 6), resembles *tympanifer* except that the tympanum is less distinct, being practically hidden by granules; the mid-dorsal region is as thickly granulated with porous, crater-like tubercles as the sides, and the ventral surface is more distinctly granulated. There is a distinct swelling on either side behind the eyes, in the region of the parotoid glands.

This specimen seemed to suit the description of *pentheri*, Wern., but for the fact that it says, "Unterseite dicht durch Querfalten gerunzelt, aber nicht granuliert."

On the other hand, it may be the same as that named *verrucosus* by Rapp, notwithstanding that he says "Das Trommelfell verdeckt," for it would be quite easy in this case to overlook the tympanum.

Systematics, if scientific, must take into consideration exceptional specimens even if they differ but slightly from existing forms, for such exceptions are of great importance from a taxonomic, evolutionary, and distributional point of view. Our aim should be to depict the true state of things in Nature, even if thereby our definitions are obscured.

To the six previously described species four new species are now being added. One, for which the name *B. montanus* is proposed, is a small gibbose race nearly related to *B. mossambicus*, but differing principally in the length of the fourth finger, and the more granular appearance.

Another, for which the name *B. rosei* is suggested, resembles *B. gibbosus* in many respects, but differs from it in the more slender habit, in the smoothness of the skin, and, principally, in the dimensions of the pelvis, the length and breadth of which in *gibbosus* are as 4 : 5, whereas in *rosei* the proportions are as 3 : 4·5 (see Plate XLIII, figs. 1 and 2). A third form, from Port Nolloth, Namaqualand, is being called *B. namaquensis*. This species is close to *B. macrops*, but differs principally in the longer fourth finger and the longer toes. A fourth, which resembles *tympanifer* in having a distinct tympanum, is being named *B. rugosus*.

The author recognises three distinct groups arranged according to snout and eye characters :—

- I. **The Gibbosus Group**—*gibbosus*, *rosei*, *fuscus*, *tympanifer*, and *rugosus*.
- II. **The Mossambicus Group**—*mossambicus*, *parvus*, and *montanus*.
- III. **The Macrops Group**—*macrops* and *namaquensis*.

The following are the tabulated results of the examination of all the available material :—

	Number of Specimens examined.	Length of Snout * into Length of Body. †		Length of Fourth Finger as compared with that of the Second.		Diameter of Eye-cleft into Length of Body.		Base of Inner Metatarsal Tubercle to Axis of Longest Toe in Degrees.	Average Size ‡ of Species measured from Snout to Vent in Millimetres.
		From	Average.	From	Average.	From	Average.		
-I.	<i>Breviceps gibbosus</i>	7 $\frac{3}{8}$ to 10 $\frac{1}{6}$	8.24	$\frac{3}{8}$ to $\frac{3}{8}$	.78	9 to 14 $\frac{1}{2}$	10.71	50° to 60°	Males 44.75, females 53.66
	" <i>fuscus</i>	6 $\frac{1}{6}$ to 10 $\frac{3}{8}$	7.34	$\frac{3}{8}$ to $\frac{1}{2}$	.69	7 $\frac{3}{4}$ to 12 $\frac{1}{4}$	10.59	60°	" 31.77, " 45.66
	" <i>rossi</i>	7		$\frac{3}{8}$ to $\frac{3}{8}$	.70	11 $\frac{3}{8}$		30°	" ? " 35.5
II.	" <i>tympanifer</i>	6 $\frac{3}{8}$ to 8 $\frac{1}{2}$	7.3	$\frac{3}{8}$ to $\frac{3}{8}$	.70	10 to 11 $\frac{1}{2}$	10.87	50° to 60°	" 33.0, " 48.0
	" <i>rugosus</i>	5 $\frac{5}{6}$ to 6 $\frac{3}{8}$	6.28	$\frac{3}{8}$ to $\frac{3}{8}$	.68	11 to 13	11.0	40° to 45°	" 33.0, " 33.0
	" <i>mosambicus</i>	4 to 6	5.11	$\frac{1}{4}$ to $\frac{1}{2}$	.44	6 $\frac{3}{8}$ to 11 $\frac{3}{8}$	8.24	40° to 45°	" 33.62, " 46.25
	" <i>parvus</i>	4 $\frac{3}{8}$ to 6	5.10	$\frac{3}{8}$ to $\frac{3}{8}$	.60	7 $\frac{3}{8}$ to 11	8.92	30° to 45°	" 24.0, " 28.0
III.	" <i>montanus</i>	5 to 7	5.83	$\frac{1}{2}$ to $\frac{1}{2}$	.8	8 $\frac{1}{2}$ to 9 $\frac{1}{2}$	8.63	30° to 40°	" 30.5, " 32.25
	" <i>macrops</i>	3 $\frac{3}{8}$ to 4 $\frac{1}{2}$	3.78	$\frac{1}{3}$ to $\frac{1}{2}$	.44	4 $\frac{9}{11}$ to 5 $\frac{7}{7}$	5.22	Parallel or 30°	
	" <i>namaquensis</i>	4 $\frac{1}{2}$ to 5 $\frac{1}{6}$	4.72	$\frac{3}{8}$ to $\frac{1}{2}$	.70	6 $\frac{1}{2}$ to 6 $\frac{5}{6}$	6.66	30° to 50°	40.0

* Measured from a line joining the posterior corners of the eye-openings to the tip of the snout between the nostrils

† Measured from snout to vent.

‡ In some cases general averages only are given, as the lengths of the sexes are not definitely known.

DESCRIPTIONS OF THE GENUS AND SPECIES.

BREVICEPS.

Merrem, Trent. Syst. Amph., p. 178.

Pupil horizontal. Tongue elongate, oval, entire, free behind, tip frequently recurved either superiorly or inferiorly. Palate papillose. Fingers and toes free, the tips not dilated. Outer metatarsals united. Coracoids very much dilated; precoracoids well developed; no omosternum; sternum very small, cartilaginous. Sacral vertebrae with very strongly dilated diapophyses, confluent with coccygeal style. Limbs very short, terminal phalanges simple. An oblique, dark-coloured, fairly broad streak extending from below the eye towards the base of the fore-limb invariably present.

Breviceps gibbosus (Plate XLI, fig. C).

Linné, Syst. Nat., i, p. 211 (1758).

Habit extremely stout. Head very short, scarcely distinct from body; snout truncate (Plate XXXIX, fig. 4), sometimes on a level with a line joining the anterior angles of the eyes, $7\frac{1}{2}$ to $10\frac{1}{6}$ times into length of body. Eyes comparatively small, directed forward, diameter of cleft 9 to $14\frac{2}{7}$ times into length of body; inter-orbital space about equal to the width of the upper eyelid. Tympanum hidden. Fingers and toes rather thickset; fourth finger from $\frac{2}{3}$ to $\frac{8}{9}$ as long as the second; fifth toe fairly well developed; a large, flat, oval tubercle at the origin of each finger and toe, usually a rather indistinct one under the centre joint of the longest toe; palms of hands and soles of feet wrinkled into large folds. Inner metatarsal tubercle very large, thick, and blunt, axis 50° to 60° to that of the longest toe; outer metatarsal large, prominent, scarcely distinct from the inner. Body very rough throughout, covered with rather small tubercles, which are deeply pitted, giving them a crater-like appearance. Ventral surface sometimes finely granular, extremely so submentally, or wrinkled into horizontal folds.

Colour.—Above, olive or a brown sand colour with a mixture of dark and whitish speckles, sometimes with rather indistinct dorsal and lateral stripes; below, a plain dull ochre yellow, sometimes feebly speckled with light brown or vermiculated with reddish brown.

Average length of males 44.75 mm., females 53.66 mm.

DISTRIBUTION :—

Cape Peninsula.—Newlands, Rondebosch, Wynberg and Claremont, Camps Bay, Cape Town.

Breviceps mossambicus (Plate XLI, fig. A).

Peters, Arch. Naturg., vol xxi, pt. 1, p. 58 (1855).

Habit very stout. Head moderately large, quite distinct; snout fairly prominent (Plate XXXIX, fig. 8), measuring 4 to 6 times into length of body. Eye small, diameter of cleft $6\frac{2}{5}$ to $11\frac{3}{4}$ into length of body; inter-orbital space much greater than the width of the upper eyelid. Tympanum hidden. Fingers and toes rather thickset; fourth finger from $\frac{1}{4}$ to $\frac{2}{5}$ as long as the second; fifth toe rudimentary. A large wedge-shaped tubercle at the origin of each finger, a few scattered, rounded, or flat ones on the palms of the hands, rather indistinct subconical ones on the inner sides of the toes; soles of feet smooth. Inner metatarsal tubercle large with long, rather blunt, digging edge at right angles to the sole of the foot, or turned in towards it; base at 40° to 45° to axis of longest toe. Outer metatarsal small and distinct, or fairly large and scarcely distinct from the inner. Body above, quite smooth but porous throughout, or latter half with flat tubercles or granules; sides granular; or whole dorsal surface and sides covered with hard rounded granules or with soft blister-like excrescences. Below, quite smooth, or granular on the abdomen and sides.

Colour variable, but markings fairly constant. The ground colour above may be brown, very dark grey, reddish brown, or light pink, with a large irregular spot on either side of the vertebral line between the arms, two indistinct spots on the centre of the back, four or five irregular lateral spots; these may be light yellow, whitish, pink, or vermilion according to the body colour. A light vertebral line may or may not be present. Below, ochre yellow with spots or vermiculations on the sides of the body and on either side submentally. Occasionally, especially in the males, the whole under-surface of the head is thickly vermiculated.

Average length of males 33.62 mm., females 46.25 mm.

DISTRIBUTION :—

Cape Province.—Kimberley, Grahamstown; Kuruman; Qacu Forest, near Cathcart.

Natal.—Mariannahill; Weenen.

Zululand.—Umlatuzi River.

Portuguese East Africa.—Delagoa Bay; Rikatla.

Transvaal.—Jericho, Pretoria Dist.; Clearwater, Haenertsburg; Shilowane, Zoutpansberg; Barberton; Shahole, near Gravelotte; Hectorspruit, Louw's Creek, Komati-poort; Barberton Dist.; Pietersburg; Mokoetsi River; Rustenburg; White River; Dientje, P.O. Valhoek.

Bechuanaland Protectorate.—Mochudi; Serowe.

South-west Africa.—Kaoko Otavi, Feb. 1926.

Southern Rhodesia.—Hunyain; Bulawayo; Salisbury; Insiza; Mazoe; Bindura, Mazoe Dist.; Eldorado; Empandeni.

Breviceps macrops (Plate XLII, fig. 4).

Boulenger, Ann. Mag. Nat. Hist., (7), vol. xx, p. 46 (1907).

Habit comparatively slender. Head large; snout comparatively long (Plate XXXIX, fig. 1), $3\frac{2}{3}$ to $4\frac{1}{3}$ times into length of body. Eye large, diameter of cleft $4\frac{9}{11}$ to $5\frac{1}{4}$ times into length of body; inter-orbital space narrow, barely half the width of the upper eyelid. Tympanum hidden. Fingers and toes shorter and thicker than in any other species of the genus; fourth finger, and first, second, third, and fifth toes often merely rudimentary stumps; fourth finger from $\frac{1}{3}$ to $\frac{1}{2}$ as long as the second. Palms of hands and soles of feet perfectly smooth or with small, tapering, very soft tubercles at the base, and at each joint of the second and third fingers. Inner metatarsal tubercle feebly prominent, long and narrow, not projecting beyond the side of the foot, parallel to, or at 30° to axis of longest toe; outer metatarsal absent or very indistinct.

Body above, smooth, the head, legs, and arms having a high polish, or latter $\frac{2}{3}$ of the body covered with small, flat, pitted tubercles; below, smooth or skin folded slightly on the abdomen and sides.

Colour above, sandy brown with dark markings, or whitish with faint reddish-brown irregular blotches. A semicircular reddish-brown band passing over each eyebrow and across the forehead in front of the eyes; an irregular curved band from one eyelid to the other across the back of the head; arms, legs, and lower parts white.

Average length 32.25 mm.

DISTRIBUTION.—Port Nolloth, Namaqualand.

Breviceps fuscus (Plate XLI, fig. D).

Hewitt, Ann. Natal Mus., vol. v, pt. 2, p. 191 (1925).

Habit extremely stout. Head very short; snout (Plate XXXIX, fig.

3) very short, $6\frac{1}{5}$ to $10\frac{8}{3}$ times into length of body, not projecting beyond the lower lip, which is vertical. Eyes small, directed forward, diameter of cleft $7\frac{3}{4}$ to $12\frac{1}{4}$ times into length of body; inter-orbital width about equal to the width of the upper eyelid. Tympanum hidden. Fingers and toes short and thickset; feet comparatively short; fourth finger $\frac{2}{3}$ to $\frac{6}{7}$ as long as the second; fifth toe well developed. A large flat or subconical tubercle at the base of each finger and toe, this sometimes semidivided, sometimes very faint, occasionally an indistinct tubercle at the middle articulation of the third finger and fourth toe; palms of the hands with skin folds, giving them a rough appearance; soles of feet smooth, or with very faint, tiny granules. Inner metatarsal tubercle large, very blunt, sometimes quite oval and pebble-like, with no digging edge and having a flat patch worn in the centre. Outer metatarsal a large subcircular pad, more or less distinct from the inner.

Body above, very granular and pitted, especially the top, sides, and under-part of the head; the granules not so thick and more or less regularly spaced mid-dorsally; thickly granular on the sides, upper arms, and legs; chest more or less smooth; granules indistinct on the abdomen.

Colour above, uniform very dark brown, paler on the sides; below, a dull, reddish yellow, except the submental region, which is coloured like the dorsal surface.

Average size: males 31.77 mm., females 45.66 mm.

DISTRIBUTION.—Knysna; George.

Breviceps tympanifer (Plate XLI, fig. E).

Hewitt, Ann. Natal Mus., vol. v, pt. 2, p. 190 (1925).

Habit fairly long and stout. Head broad; snout (Plate XXXIX, fig. 5) very short, $6\frac{2}{5}$ to $8\frac{1}{3}$ into length of body, not projecting beyond the lower lip, which is vertical. Eye small, diameter of cleft 10 to $11\frac{1}{2}$ times into body. Inter-orbital width greater than the width of the upper eyelid. Tympanum distinct, vertically oval; diameter about $\frac{2}{3}$ of the eye opening. Body above, porous throughout, densely granulated, but without asperities or warts; below, distinctly granulated but much weaker than on the dorsal surface. Fingers and toes with a large flat, oval or round, rather indistinct pad at the base of each, also an indistinct tubercle at each articulation; palms of hands and soles of feet wrinkled into folds. Inner metatarsal tubercle very thick, short, and blunt, sometimes almost merging into the outer;

projecting beyond the side of the foot ; no digging edge ; axis of base at from 50° to 60° to that of longest toe. Outer metatarsal a large subcircular pad distinct from the inner. Fourth finger $\frac{2}{3}$ to $\frac{3}{4}$ as long as the second ; fifth toe fairly well developed.

Colour.—Above, brown, thickly speckled with dull yellow. Over a broad mid-dorsal area in the anterior half of the body, yellow predominates. A distinct mid-dorsal stripe on the posterior quarter of the body ; this divides into two, just above the vent, which pass along the backs of the legs to the base of the fifth toe. Below, a reddish-yellow or smoky colour, particularly on the abdomen ; submental region pale yellow.

Average length : males 33.0 mm., females 43.0 mm.

DISTRIBUTION.—Pirie, near Kingwilliamstown ; Hogsback, Amatola Range ; Port St. Johns.

Breviceps parvus (Plate XLI, fig. B).

Hewitt, Ann. Natal Mus., vol. v, pt. 2, p. 192 (1925).

Habit short and stout ; head moderately large ; snout (Plate XXXIX, fig. 7) projecting, rather prominent, $4\frac{1}{3}$ to 6 times into length of body. Eye small, diameter $7\frac{1}{3}$ to 11 times into length of body, much greater than the distance between the nostril and the anterior angle of the orbit ; interorbital width about equal to the width of the upper eyelid. Above, quite smooth or with large flat tubercles ; slightly granular laterally. Below, quite smooth or with transverse folds in the abdominal region, slightly granular on the chin ; skin sometimes folded irregularly at the sides ; arms and legs smooth. Fingers and toes slender, bluntly pointed at the tips, a large rounded tubercle at the origin of each finger and toe, a smaller one at each articulation ; fourth finger from $\frac{2}{3}$ to $\frac{4}{5}$ as long as the second ; palmar tubercles large and rounded or finely granular ; soles of feet smooth. Inner metatarsal tubercle kidney-shaped, standing at right angles to, or directed inwards towards, the sole of the foot ; not extending beyond the side of the foot, digging edge rather sharper than in *B. mossambicus*, its axis from 30° to 45° to that of the longest toe.

Colour, slaty grey dorsally with lighter grey spots and blotches at either side of the mid-dorsal line and at the sides. Whitish beneath, often spotted or marbled with slaty grey or greyish black ; a dark oblique streak on the cheek below the eye ; throat and chin dark grey, sometimes almost black, in others speckled with grey.

Total length 28 mm.

DISTRIBUTION :—

Cape Province.—Grahamstown ; Stone Hill, Brok Kloof, Cold-spring, near Grahamstown ; Alicedale ; Port St. Johns.

Zululand.—Mseleni.

Portuguese East Africa.—Lourenço Marques ; Masiene, near Chai Chai.

Transvaal.—Barberton ; Worcester Mine, Barberton Dist. ; Kastrol Nek, Wakkerstroom Dist. ; Louw's Creek ; Komatipoort.

***Breviceps namaquensis*, sp. nov.** (Plate XLII, fig. 3).

This species is founded on two specimens, in the South African Museum, from Port Nolloth, collected by C. L. Biden and W. C. Scully.

Habit comparatively slender. Head large ; snout (Plate XXXIX, fig. 2) comparatively long, $4\frac{1}{3}$ to $5\frac{1}{3}$ times into length of body, projecting slightly beyond the lower lip, which is obtusely pointed.

Eye large, diameter of cleft $6\frac{1}{2}$ to $6\frac{5}{8}$ times into length of body ; interorbital space about half the width of the upper eyelid. Tympanum hidden. Fingers and toes fairly slender ; fourth finger from $\frac{3}{5}$ to $\frac{4}{5}$ as long as the second ; fifth toe fairly well developed ; fingers and palms of hands thickly granulated with small conical tubercles ; third and fourth toes with a small conical tubercle under each articulation ; soles of feet perfectly smooth. Inner metatarsal tubercle distinct but not well developed, having a sharp digging edge, making an angle of 30° to 50° with axis of longest toe ; outer metatarsal narrow and in line with the inner, having a slight indication of a digging edge. Body smooth throughout, or the latter third of the dorsal surface, the sides, abdomen, and submental region finely granular.

Colour above, black or dark reddish brown with a light brown or whitish patch on either side of the vertebral line behind the head, sometimes a whitish bar across the forehead. Two spots on either side mid-dorsally, sometimes followed by a T-shaped mark, and a spot on either side of the vertebral line in the sacral region. The two spots just behind the head sometimes elongate and joined in the centre, forming an H-shaped mark.

The body may be highly polished throughout the whole dorsal surface. Below, uniformly yellowish.

Average length 40 mm.

DISTRIBUTION.—Port Nolloth, Namaqualand.

This species resembles *B. macrops* in size and general appearance. It differs from it, however, in very essential characters, such as the rough hands and longer fourth finger.

Breviceps montanus sp. nov. (Plate XLIII, figs. 3 and 4).

The types of this species are two specimens in the South African Museum, Cape Town, and one in the Albany Museum, Grahamstown, all from Table Mountain, collected by H. W. Oakley, W. L. Selater, and F. Cruden.

The characters are: Habit short and very stout. Head small; snout (Plate XXXIX, fig. 9) short, but longer than in *gibbosus*, 5 to 7 times into length of body, projecting beyond the lower lip. Eye-opening comparatively large, diameter $8\frac{1}{3}$ to $9\frac{1}{3}$ times into length of body, more than twice the distance from its anterior angle to the nostril; interorbital width about equal to the width of the upper eyelid. Tympanum hidden. Body, arms, legs, hands, and feet densely granular throughout (see figs. 3 and 4, Plate XLIII); those on the dorsal surface being very small, and rather scattered in the mid-dorsal region. Skin without folds. Fingers and toes rather slender, bluntly pointed; the fourth finger $\frac{1}{3}$ as long as the second; fifth toe a mere bud. Inner metatarsal tubercle prominent, oval, and pebble-like, no digging edge; projecting beyond the side of the foot; axis of base 30° to 40° to axis of longest toe; outer metatarsal comparatively large, distinct, or hardly so, from the inner.

Colour, black above with indistinct brownish-grey markings; below, and on the sides, dark ochre yellow; or grey speckled with dark brown on the sides and ventral surface, save the posterior third; or vermiculated with black, thickly so submentally. Specimens a long time in spirit become a uniform yellowish colour.

Average length 30.5 mm.

DISTRIBUTION.—Table Mountain.

This species is near *mossambicus*, from which it differs in the length of the fifth toe and the granulation of the body.

Breviceps rosei sp. nov. (Plate XLII, figs. 1 and 2).

This species is based on a specimen collected on the Cape Flats, at Lakeside, by Mr. Walter Rose. The type is preserved in the M'Gregor Museum, Kimberley.

Habit short and fairly slender. Head moderately large; snout

(Plate XXXIX, fig. 10) rather prominent, 7 times into length of body ; chin obtusely pointed. Eye small, $11\frac{2}{3}$ times into length of body, greater than the distance between its anterior angle and the nostril. Interorbital space about equal to the width of the upper eyelid. Fingers and toes slender, tapering towards the tips ; fourth finger $\frac{2}{3}$ as long as the second ; fifth toe but slightly shorter than the second. Inner metatarsal large with blunt digging edge at 30° to axis of longest toe ; outer metatarsal forming a large, hard, subcircular pad, distinct from the inner. Body above more or less smooth with large, very flat, and indistinct blister-like excrescences ; the forehead, subocular region, sides of the head behind the eyes, sides of the body and abdominal region finely granular ; upper surface of the arms and the chin faintly granular ; upper surface of legs and feet quite smooth. Palms of the hands covered with large rounded tubercles, also one at the base of each finger and toe ; soles of feet wrinkled.

Colour, dark above with indistinct brown markings ; a brown patch on the forehead between the eyes, also on the side of the head behind the eyes. Below, whitish, speckled with black on the sides and belly ; submental region and chest thickly vermiculated with black.

Total length 35.5 mm.

DISTRIBUTION.—Lakeside, Cape Peninsula.

This species differs from *gibbosus* in the longer snout, smaller size, angle of metatarsal tubercle, the comparatively slender and smooth body, and the comparative dimensions of the pelvic arch (see Plate XLIII, figs. 1 and 2).

Two specimens from Robben Island in the South African Museum might be referred to this species. The bodies of these latter were so dense that they proved impervious to the X-ray.

***Breviceps rugosus* sp. nov.** (Plate XLII, figs. 8 and 9).

The type of this species is a specimen from Mariannahill, Natal, preserved in the Kimberley Museum. Collected by Br. Felix. Two others from Umbilo, Natal, in the Durban Museum, and two from Maxambuli, Transkei, in the Albany Museum, Grahamstown, also belong to this species.

This species resembles *tympanifer*, Hewitt, in having a distinct tympanum, but the differences between the two forms are considerable.

The characters are : Habit short and extremely stout. Head very small ; snout (Plate XXXIX, fig. 6) fairly prominent, $5\frac{0}{10}$ to $6\frac{2}{3}$ times into length of body ; projecting beyond the lower lip, which is nearly

vertical. Eye very small, diameter 11 to 13 times into length of body; interorbital width about equal to the width of the upper eyelid. Tympanum distinct, subcircular, diameter two-thirds that of the eye-opening. Dorsally, arms and legs with scattered granules, some of which are pitted, sometimes arranged in more or less longitudinal series. Ventrally, with flattened or rounded tubercles distributed throughout, usually small and granular under the head, sometimes fairly smooth on the centre of the abdomen. Skin without folds. Fingers and toes slender, bluntly pointed at the tips; a large blister-like, oval or rounded pad at the base of each finger, smaller and less distinct ones at the base of each toe; a very small tubercle at each articulation of fingers and toes. Palms of hands with large blister-like folds; soles of feet with small, rounded, rather indistinct granules. Fourth finger from $\frac{2}{3}$ to $\frac{3}{4}$ as long as the second; fifth toe fairly well developed. A large and prominent inner metatarsal tubercle, pebble-like, not projecting beyond the side of the foot; no digging edge; lying flat on the sole of the foot or projecting slightly beyond it; a small oval patch sometimes worn flat on the otherwise rounded surface. Outer metatarsal comparatively large, semi-oval, distinct from the inner. Axis of base of inner metatarsal 40° to 45° to that of longest toe.

Colour, a very light brownish yellow or dark grey dorsally, many of the granules being tipped with brown, giving a spotted effect; ventrally, whitish, with sometimes grey vermiculations.

Average length 33.0 mm.

DISTRIBUTION.—Mariannhill, Umbilo, Natal; Maxambuli, Transkei.

Key to the Species.

I. Snout truncate or very short, averages 6 to 8 times into body.

Eye very small, averages 10 or 11 times into body.

- | | |
|---|--------------------|
| a. Tympanum hidden; extremely stout; skin porous throughout and distinctly granular. Average size of ♀ 53 mm. | <i>gibbosus.</i> |
| Tympanum hidden; extremely stout; skin very rough throughout. Average size of ♀ 45 mm. | <i>fuscus.</i> |
| Tympanum hidden; comparatively slender; skin almost smooth dorsally. Size of ♀ 35 mm. | <i>rosei.</i> |
| b. Tympanum distinct; extremely stout; skin porous throughout, densely granular but not rough. Average ♀ 48 mm. | <i>tympanifer.</i> |
| Tympanum distinct; extremely stout; skin with rough scattered granules. Average ♀ 33 mm. | <i>rugosus.</i> |

- II. Snout fairly prominent, averages 5 times into body. Eye fairly small, averages 8 times into body.
- | | |
|---|---------------------|
| Fourth finger $\frac{1}{4}$ to $\frac{3}{8}$ times as long as the second. Smooth ventrally. Average ♀ 46.25 mm. | <i>mossambicus.</i> |
| Fourth finger $\frac{2}{3}$ to $\frac{1}{2}$ times as long as the second. Smooth ventrally. Average ♀ 28.0 mm. | <i>parvus.</i> |
| Fourth finger $\frac{1}{2}$ times as long as the second. Extremely rough ventrally. Average ♀ 30.5 mm. | <i>montanus.</i> |
- III. Snout fairly prominent, 3 or 4 times into body. Eye large, averages 5 or 6 times into body.
- | | |
|--|---------------------|
| Fourth finger $\frac{1}{3}$ to $\frac{1}{2}$ times as long as the second. Palmar region smooth | <i>macrops.</i> |
| Fourth finger $\frac{2}{3}$ to $\frac{1}{2}$ times as long as the second. Palmar region very rough | <i>namaquensis.</i> |

CONCLUSION.

Although there are several instances, in the records given, of closely allied forms occurring in the same locality, e.g. *mossambicus* and *rugosus* from Mariannahill, *macrops* and *namaquensis* from Port Nolloth, they may be separated topographically. The late Dr. L. Péringuey, writing on one occasion to the author, describes the latter locality as follows: "From Port Nolloth to a distance of 12 miles there is nothing but sandhills or sand hummocks *ad infinitum*, and during the dry season they become carpeted with flowers after the first rains. Ograbies, 15 miles north from Port Nolloth, is partly rocky, partly sandy. From Ograbies the sand ceases, and is replaced to Anenus railway station (50 miles from Port Nolloth), where the heavy ascent of the mountain begins, by rocky, grassy, or bushy ground." It is very probable that *B. namaquensis* will be found to prefer the rocky ground inland from Port Nolloth, while *B. macrops* will show a preference for the sandy ground near the coast. The insufficient localisation of their captures by collectors is notorious, consequently records are not always trustworthy.

Agama atra, in the neighbourhood of Kimberley, is confined to the kopjes, while *Agama aculeata* prefers the open veld. This preference for a peculiar type of environment is shared by many other reptiles, batrachians, and mammals.

Dr. Broom,* in a paper entitled "A Contribution to the Knowledge of the Cape Golden Moles," says: "At Stellenbosch they apparently keep certain regions to themselves. Thus, in my garden *C. hottentota* is the species commonly met with, while across the road in the college

* Trans. S. Afr. Phil. Soc., vol. xviii, p. 296 (1907).

quadrangle *C. asiatica* most commonly occurs. It appears probable that *C. asiatica* prefers the drier and sandier soil, and *C. hottentota* the rich garden soil."

Again, Dr. Duerden,* writing of the tortoises of the geometric group, says: "If one were able to study the peculiarities of the environment closely, there is little doubt that the variations would be found to be largely adaptative." Even in very limited areas, such as the Cape Peninsula, one may find a number of quite different environments and climates. An intensive study of such a locality as this, from which closely allied species are recorded, is very desirable. It is probable that *B. montanus* will not be found below certain altitudes of the mountain, *B. rosei* may prove to be confined to the Flats, while *B. gibbosus* would occupy the intermediate area.

* S. Afr. Assoc. for Adv. Sc., Kimb., 1906, p. 205.

EXPLANATION OF PLATES.

PLATE XXXIX.

FIG.

1. Profile of *Breviceps macrops*.
2. " " " *namaquensis*.
3. " " " *fuscus*.
4. " " " *gibbosus*.
5. " " " *tympanifer*.
6. " " " *rugosus*.
7. " " " *parvus*.
8. " " " *mossambicus*.
9. " " " *montanus*.
10. " " " *rosei*.

PLATE XL.

- a. Ventral aspect of hand and foot of *Breviceps parvus*.
- b. " " " " " *gibbosus*
- c. " " " " " *montanus*.
- d. " " " " " *fuscus*.
- e. " " " " " *macrops*.
- f. " " " " " *mossambicus*.
- g. " " " " " *namaquensis*.
- h. " " " " " *rugosus*.
- i. " " " " " *rosei*.
- j. " " " " " *tympanifer*.

PLATE XLI.

- A. Both sexes of *Breviceps mossambicus*.
- B. " " " *parvus*.
- C. " " " *gibbosus*.
- D. " " " *fuscus*.
- E. " " " *tympanifer*.

PLATE XLII.

- 1 and 2. Dorsal and ventral views of *Breviceps rosei* sp. nov. Photos by W. Rose.
3. *Breviceps namaquensis* sp. nov., ventral view.
4. " *macrops* Bouleng., ventral view.
- 5 and 6. Dorsal and ventral views of a specimen from Hottentot's Holland Mountains, eastern side.
- 7 and 8. *Breviceps tympanifer* Hewitt, and *Breviceps rugosus* sp. nov., photographed side by side for comparison.
9. *Breviceps rugosus* sp. nov., ventral aspect.

PLATE XLIII.

1. X-ray of *Breviceps gibbosus* by W. Rose.
2. " " *rosei* by W. Rose.
- 3 and 4. " *montanus* sp. nov., dorsal and ventral views.